MEASUREMENTS OF SILICA EXCESS IN PLAGIOCLASE IN CHONDRULES FROM PRIMITIVE CARBONACEOUS CHONDRITES: IMPLICATIONS FOR ^{26}Al-^{26}Mg SYSTEMATICS.

N. Chaumard[1], A. T. Hertwig[1], N. T. Kita[1], and T. J. Tenner[2], and M. Kimura[3], [1]WiscSIMS, Dept. of Geoscience, Univ. of Wisconsin-Madison, USA (chaumard@wisc.edu), [2]Los Alamos National Laboratory, New-Mexico, USA, [3]National Institute of Polar Research, Tokyo, Japan.

Introduction: The short-lived radionuclide ^{26}Al-^{26}Mg system ($\tau_{1/2}$ ~0.7 Myr) has been extensively applied to the chronology of chondrules [e.g., 1], in which An-rich plagioclase is an important mineral for SIMS ^{26}Al-^{26}Mg measurements [e.g., 2, 3]. However, the ^{26}Al-^{26}Mg system in plagioclase can be disturbed by thermal metamorphism that causes redistribution of Mg by diffusion [4, 5] and/or aqueous alteration that replaces anorthite by nepheline and sodalite [6]. Recently, [7] reported low cation totals and silica excess in An-rich plagioclase in chondrules from CR chondrites and Acfer 094, similar to those in lunar plagioclase [8]. The silica excess in plagioclase is a primary crystallization feature that is explained by a coupled substitution resulting in a vacancy and silica excess [8, 9]. Thus, plagioclase showing silica excess in chondrules from pristine chondrites may provides reliable ^{26}Al-^{26}Mg chronology [7]. Here we examine chondrule plagioclase compositions in carbonaceous chondrites (CCs) with petrologic subtypes 3.05-3.1 that have been studied for ^{26}Al-^{26}Mg chronology in the past [e.g. 1, 10].

Samples and Method: We analyzed crystalline plagioclase in chondrules from Yamato (Y-) 81020 (CO3.05; [11], n=17), Asuka (A-) 881632 (CO3.1; [12], n=17), and Kaba (CV~3.1; [13], n=5). We acquired a total of 123 quantitative analyses using a Cameca SXFive FE electron microprobe at the UW-Madison. To avoid Na migration during measurement, we used an accelerating voltage of 15 kV and a beam current of 10 nA. Using a focused beam, we counted 10 s. on peak and 5 s. on the background before and after. We used several standards of crystalline plagioclase with compositions ranging from An_1 to An_{95} to determine Ca, Na, Al, and Si concentrations, and synthetic forsterite for Mg. We used microcline, rutile, fayalite, synthetic Cr_2O_3, and synthetic Mn-olivine for K, Ti, Fe, Cr, and Mn, respectively. Major oxide totals of all the plagioclase standards analyzed range from 98.4 to 100.9 wt%, with a sum of cations between 4.982 and 5.011 on the basis of 8 oxygens. We calculated the endmember components of our analyses following [8] and silica excess ($[]Si_4O_8$,) is given as the mole fraction. No silica excess was observed from terrestrial plagioclase standards within analytical uncertainties of ±0.02 (2SD), which is considered to be the limitation of identifying silica excess/deficit in the current method.

Results: Results of the individual plagioclase analyses are summarized in Table 1. Oxide totals of all analyses were 100.0±1.0%. In CO3, the values of Si excesses are generally consistent within each chondrule. In 5 and 4 chondrules from Y-81020 and A-881632, respectively, all plagioclase grains consistently show Si excesses higher than 0.02. The silica excess is weakly correlated with the An and MgO contents of plagioclase. Plagioclase grains in 3 chondrules from A-881632 that display the lowest values of $[]Si_4O_8$ (from –0.03 to –0.04) have lower An and MgO contents than those with positive $[]Si_4O_8$ values.

Discussion: Our results suggest that some plagioclases in 3.05-3.1 CCs retained silica excess since their chondrule formation, so that they are suitable for ^{26}Al-^{26}Mg chronology. However, these new data from 3.05-3.1 CCs are systematically lower in both An and silica excess compared to plagioclase in Acfer 094 and CR3 chondrites. In Y-81020, there is no obvious difference in inferred initial ^{26}Al/^{27}Al ratios [2] and MgO contents among chondrules with/without silica excess. Then, the preservation of silica excess in plagioclase might be more sensitive to secondary parent body processes than Mg diffusion.

Table 1: Chemical compositions and Si excesses in plagioclase in chondrules calculated in this work.

Meteorite	Numbers of data*	Σ Cations	$[]Si_4O_8$ mol. fract.		An mol. fract.		MgO
			min	max	(type I, Al-rich)	(type II)	(wt %)
Y-81020 (CO3.05)	69 (35)	4.905 - 5.026	–0.03	+0.09	0.78-1.00	0.46-0.67	0.2-1.4
A-881632 (CO3.1)	44 (31)	4.920 - 5.062	–0.05	+0.08	0.65-0.99	0.51-0.59	0.1-1.3
Kaba (CV3.1)	10 (1)	4.966 - 5.014	–0.02	+0.04	0.83-0.96		0.6-1.2

*Values in parenthesis are the number of analyses with Si excess > 0.02 mole fraction.

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